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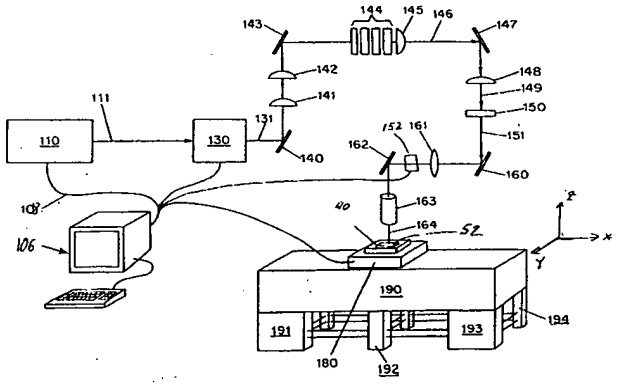
(54) Title: METHOD AND APPARATUS FOR PROCESSING THIN METAL LAYERS



(57) Abstract: A method and apparatus for processing a thin metal layer on a substrate to control the grain size, grain shape, and grain boundary location and orientation in the metal layer by irradiating the metal layer with a first excimer laser pulse having an intensity pattern defined by a mask to have shadow regions and beamlets. Each region of the metal layer overlapped by a beamlet is melted throughout its entire thickness, and each region of the metal layer overlapped by a shadow region remains at least partially unmelted. Each at least partially unmelted region adjoins adjacent melted regions. After irradiation by the first excimer laser pulse, the melted regions of the metal layer are permitted to resolidify. During resolidification, the at least partially unmelted regions seed growth of grains in adjoining melted regions to produce larger grains. After completion of resolidification of the melted regions following irradiation by the first excimer laser pulse, the metal layer is irradiated by a second excimer laser pulse having a shifted intensity pattern so that the shadow regions overlap regions of the metal layer having fewer and larger grains. Each region of the metal layer overlapped by one of the shifted beamlets is melted throughout its entire thickness, while each region of the metal layer overlapped by one of the shifted shadow regions remains at least partially unmelted. During resolidification of the melted regions after irradiation by the second radiation beam pulse, the larger grains in the at least partially unmelted regions seed growth of even larger grains in adjoining melted regions. The irradiation, resolidification and re-irradiation of the metal layer may be repeated, as needed, until a desired grain structure is obtained in the metal layer.

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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01L21/768

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01L B23K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, INSPEC, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	HAU-RIEGE C S ET AL: "The effects of microstructural transitions at width transitions on interconnect reliability" JOURNAL OF APPLIED PHYSICS, 15 JUNE 2000, AIP, USA, vol. 87, no. 12, pages 8467-8472, XP002200743 ISSN: 0021-8979 the whole document --- -/--	1

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

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Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Königstein, C

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SPOSILI R S ET AL: "SEQUENTIAL LATERAL SOLIDIFICATION OF THIN SILICON FILMS ON SIO2" APPLIED PHYSICS LETTERS, AMERICAN INSTITUTE OF PHYSICS. NEW YORK, US, vol. 69, no. 19, 4 November 1996 (1996-11-04), pages 2864-2866, XP000955150 ISSN: 0003-6951 figure 1 ---	68-71
X	MCWILLIAMS B M ET AL: "WAFER-SCALE LASER PANTOGRAPHY: FABRICATION OF N-METAL-OXIDE-SEMICONDUCTOR TRANSISTORS AND SMALL-SCALE INTEGRATED CIRCUITS BY DIRECT-WRITE LASER-INDUCED PYROLYTIC REACTIONS" APPLIED PHYSICS LETTERS, AMERICAN INSTITUTE OF PHYSICS. NEW YORK, US, vol. 43, no. 10, November 1983 (1983-11), pages 946-948, XP000816966 ISSN: 0003-6951 figure 1 ---	68
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PCT/US 01/31391

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 591 668 A (MAEGAWA SHIGEKI ET AL) 7 January 1997 (1997-01-07) figures 1A,1B	

INTERNATIONAL SEARCH REPORT

Information on patent family members

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